

## Claims

- [c1] An apparatus, comprising:
- a heat generating component;
  - a heat conducting base plate thermally coupled to said heat generating component;
  - a plurality of heat conducting pin-fins, each of said pin-fins having a free end and an attachment end, the attachment end of each of said pin-fins being attached to said base plate, each of said pin-fins having an intake opening wherein the intake opening is oriented to admit cooling fluid moving in a first direction substantially parallel to said base plate, each of said pin-fins having a discharge opening for discharging cooling fluid, each of said pin-fins having a tubular channel extending from the intake opening to the discharge opening;
  - and
  - a pump system for moving cooling fluid in the first direction substantially parallel to said base plate such that cooling fluid moves over the exterior surface and through the tubular channel of each of said pin-fins.
- [c2] The apparatus of claim 1, wherein the discharge opening of each of said pin-fins is oriented to discharge cooling fluid in the first direction,  $\pm 90$  degrees.
- [c3] The apparatus of claim 2, further comprising a baffle adjacent the free end of each of said pin-fins and substantially parallel to said base plate for ducting cooling fluid between said base plate and said baffle.
- [c4] The apparatus of claim 2, further comprising a ducting system comprising:
- a first baffle adjacent the free end of each of said pin-fins and substantially parallel to said base plate; and
  - a second and third baffles positioned substantially parallel to the first direction and substantially perpendicular to said first baffle;
- wherein cooling fluid from said pump system is ducted between said first, second and third baffles and discharged from said ducting system in substantially the first direction.
- [c5] The apparatus of claim 1, further comprising a baffle adjacent the free end of each of said pin-fins and substantially parallel to said base plate for ducting

cooling fluid between said base plate and said baffle.

[c6]

The apparatus of claim 1, further comprising a ducting system comprising:  
a first baffle adjacent the free end of each of said pin-fins and substantially parallel to said base plate; and  
a second and third baffles positioned substantially parallel to the first direction and substantially perpendicular to said first baffle;  
wherein cooling fluid from said pump system is ducted between said first, second and third baffles and discharged from said ducting system in substantially the first direction.

[c7]

A heat sink, comprising:  
a heat conducting base plate;  
a plurality of heat conducting pin-fins, each of said pin-fins having a free end and an attachment end, the attachment end of each of said pin-fins being attached to said base plate, each of said pin-fins having an intake opening wherein the intake opening is oriented to admit cooling fluid moving in a first direction substantially parallel to said base plate, each of said pin-fins having a discharge opening for discharging cooling fluid, each of said pin-fins having a tubular channel extending from the intake opening to the discharge opening.

[c8]

The heat sink of claim 7, wherein the discharge opening of each of said pin-fins is oriented to discharge cooling fluid in the first direction,  $\pm 90$  degrees.

[c9]

The heat sink of claim 8, further comprising a baffle adjacent the free end of each of said pin-fins and substantially parallel to said base plate for ducting cooling fluid between said base plate and said baffle.

[c10]

The heat sink of claim 8, further comprising a ducting system comprising:  
a first baffle adjacent the free end of each of said pin-fins and substantially parallel to said base plate; and  
a second and third baffles positioned substantially parallel to the first direction and substantially perpendicular to said first baffle;  
wherein cooling fluid is ducted between said first, second and third baffles and discharged from said heat sink in substantially the first direction.

[c11] An apparatus, comprising:  
a heat generating component;  
a heat conducting base plate thermally coupled to said heat generating component;  
a plurality of heat conducting pin-fins, each of said pin-fins having a free end and an attachment end, the attachment end of each of said pin-fins being attached to said base plate, each of said pin-fins having an intake opening adjacent the free end wherein the intake opening is oriented to admit cooling fluid moving in a direction substantially perpendicular to said base plate, each of said pin-fins having a discharge opening adjacent the attachment end for discharging cooling fluid, each of said pin-fins having a tubular channel extending from the intake opening to the discharge opening; and  
a pump system for moving cooling fluid in a direction substantially perpendicular to said base plate, such that cooling fluid moves over the exterior surface and through the tubular channel of each of said pin-fins.

[c12] The apparatus of claim 11, wherein the discharge opening of each of said pin-fins is oriented to discharge cooling fluid in a general direction away from a point substantially in the center of said base plate.

[c13] The apparatus of claim 11, wherein the discharge opening of each of said pin-fins is oriented to discharge cooling fluid in a general direction along a radial line drawn from a point substantially in the center of said base plate and extending out through each of said pin-fins.

[c14] The apparatus of claim 11, wherein the discharge opening of each of said pin-fins includes a slit having one end adjacent said base plate and extending towards the free end of said pin-fins.

[c15] The apparatus of claim 14, wherein the discharge opening of each of said pin-fins is oriented to discharge cooling fluid in a general direction away from a point substantially in the center on the surface of said base plate.

[c16] The apparatus of claim 14, wherein the discharge opening of each of said pin-fins is oriented to discharge cooling fluid in a general direction along a radial

line drawn from a point substantially in the center of said base plate and extending out through each of said pin-fins.

[c17]

A heat sink, comprising:

a heat conducting base plate; and

a plurality of heat conducting pin-fins, each of said pin-fins having a free end and an attachment end, the attachment end of each of said pin-fins being attached to said base plate, each of said pin-fins having an intake opening adjacent the free end wherein the intake opening is oriented to admit cooling fluid moving in a direction substantially perpendicular to said base plate, each of said pin-fins having a discharge opening adjacent the attachment end for discharging cooling fluid, each of said pin-fins having a tubular channel extending from the intake opening to the discharge opening;

wherein the discharge opening of each of said pin-fins is oriented to discharge cooling fluid in a general direction away from a point substantially in the center of said base plate.

[c18]

The heat sink of claim 13, wherein the discharge opening of each of said pin-fins is oriented to discharge cooling fluid in a general direction along a radial line drawn from a point substantially in the center of said base plate and extending out through each of said pin-fins.